



No. 7506.02

STATINTL

STATEMENT OF WORK
for



STATINTL

25 August 1964

DECLASS REVIEW by NIMA/DOD

STATINTL



STATEMENT OF WORK

for

[REDACTED]

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STATINTL 1.0 SCOPE

1.1 This document describes the work to be performed by [REDACTED] for the design and fabrication of two each high resolution direct image optical viewer systems under [REDACTED]

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1.2 The scope of work includes the purchase and modification of lenses, design and fabrication of condenser and field lenses, and other miscellaneous optical elements, which when assembled together will comprise two each complete Experimental Direct Image Viewer Optical Systems.

2.0 APPLICABLE DOCUMENTS

This work statement is based upon information contained within the following documents, which are incorporated herein by reference.

STATINTL 2.1 [REDACTED]-S-7506, Experimental Direct Image Viewer, Specification for

3.0 REQUIREMENTS

3.1 Optical Elements

A quantity of two of each optical component described below is required except for Item 3.1.4.

3.1.1 Field Lenses

3.1.1.1 The multi-element field lenses shall be of a symmetrical design and each half separately mounted to allow installation and mounting of two diffraction gratings between the cells.

3.1.1.2 A flange type mounting arrangement shall be incorporated into the support cell structure. A 1-inch or greater spacing shall exist between the two cell structures and mounting flanges when in use.

3.1.1.3 The lens shall be approximately 15 inches in diameter (allow full coverage for 10 inch x 10 inch ruled grating) and of a focal length which will image the objective lens exit pupil 20 inches from the rear nodal point of the field lens.

3.1.1.4 The lens shall be capable of operating with, and not degrading, an objective lens capable of presenting to the observer, information from a 200 lines per millimeter low contract (1.6:1) target.

3.1.2 50X - Components

3.1.2.1 A commercial large aperture photographic lens shall be procured and modified to provide an adjustable square diaphragm (exit pupil). The characteristics of this item shall be as follows:

- a. Flange or barrel threaded mounting.
- b. The exit pupil, shall be square and as large as possible and compatible with 3.1.2.1.c.
- c. The focal length shall be 1 inch plus or minus 5%, provided this is commercially available.
- d. The resolution goal of the lens when operating at 50X shall be 200 lines per millimeter as seen in the object plane on a low contrast (1.6:1) target. The lens shall be selected to approach this objective as close as possible when testing with the wavelength band selected for the viewer. On axis resolution of the lens shall be not less than 200 lines per millimeter (high contrast).
- e. The image presented to the observer shall be an area 10 inches x 10 inches square.

3.1.2.2 A multi-element condenser system mounted in a cell shall be provided with the following characteristics:

- a. It is preferred, but not required, that the cells have flange-type mounting.

b. The condenser system shall fill the objective lens and a .2 x .2 area on the film plane.

c. The front surface of the condenser shall be half an inch or more from the film plane to provide adequate mechanical clearance.

3.1.2.3 Unmounted field flatteners shall be provided as required.

3.1.3 5X - Components

3.1.3.1 A commercial 8.5 inch focal length lens shall be procured and modified to contain an adjustable square diaphragm (exit pupil). The characteristics of this item shall be as follows:

- a. The exit pupil, when viewed by the field lens, shall provide an opening the same as that chosen under 3.1.2.1.b.
- b. This lens shall have a resolution, over the used field, of 60 lines per millimeter AWAR referred to a high contrast target in the object plane, and when tested with light of the wavelength band selected for the viewer.

3.1.3.2 A multi-element condenser system mounted in a cell shall be provided with the following characteristics:

- a. It is preferred, but not required, that the cells have flange-type mounting.
- b. The condenser system shall fill the aperture of the projection lens and a $2\frac{1}{2}$ inch square area on the film.
- c. The front surface of the condenser shall be $\frac{1}{2}$ inch or more from the film plane to provide adequate mechanical clearance.

3.1.3.3 Two separate and identical small path deflecting mirrors mounted in cells shall be provided as follows:

- a. Each mirror shall be between 3 inches in diameter and $\frac{1}{2}$ inch thick.
- b. The mirrors shall be flat over their surface to $\frac{1}{4}$ wavelength.

3.1.3.4 Unmounted field flatteners shall be provided as required.

3.1.4 Light Source Components

The central wavelength band shall be 508.6 millimicrons.

3.1.4.1 Reflectors. Two shall be supplied, one for each magnification.

3.1.4.2 Filters.

a. Interference square wave type filters shall be supplied for the elimination of the unwanted wavelengths of the light source. (Six required, three for each magnification of the following band passes: 3%, 5%, 10%)

b. Heat reflecting filters shall be supplied with each condenser system.

3.1.4.3 The illumination system (reflector lamp, condenser) shall be selected to meet the following specification at both 50X and 5X where the lowest transmission in any order of each grating is 3 per cent of the input.

3.1.4.4 Intensity specification of viewer. The viewer shall meet or exceed the following intensity criteria. The light flux presented to the eye, with an open gate, shall be equivalent to that presented to the eye by a lambertian source with a luminance of 100 foot lamberts.

3.2 Technical Specification Report

STATINTL This report shall consist of the technical data related to the above optical components, along with the required drawings so that upon receipt of this report, may proceed with the design and fabrication of the viewer. The items listed below are examples of what the report will contain.

3.2.1 Drawings showing the mounting arrangement of the field lens, objective lenses, condensers, and reflectors.

3.2.2 Focal length of all optics.

3.2.3 Optical distances between components specified in both flange distances and nodal point distances.

3.2.4 Illumination calculations, including the selection of the light source. A narrow wavelength band of 5% shall be used.

STATINTL 3.2.5 Lamp power supply information, sufficient in nature to allow to package to conform to the overall viewer design.

3.3 Engineering, Design and Description Report

This report shall contain an engineering and design description of the technical aspects of the Diffraction Viewer Optical System for integration into the engineering instruction manual. The items listed below are some of the contents of this report.

3.3.1 Technical discussions explaining the optical principles of the diffraction viewer.

3.3.2 Design consideration of the optics.

3.3.3 Consideration of an estimate of the Modulation Transfer Function of the optical system will be given (to be resolved at initial project review meeting.)

3.3.4 Instructions relating to adjustment and cleaning of the optical components.

3.4 Meetings

STATINTL During the duration of the project, periodic technical meetings will be held to review the progress of the project. The various review and progress meetings will, in most cases, occur at with the mutual agreement of the parties concerned.

4.0 SCHEDULE

The above items shall be delivered to in STATINTL concurrence with the schedule listed below:

4.1 First optical system, of the two produced (one each of the items in Section 3.1) shall be delivered not later than six (6) months after receipt of order.

4.2 The second optical system (one each of the items in Section 3.1) is not required until ten (10) months after receipt of order.

4.3 The Technical Specification Report (Item 3.2) is required two months after receipt of order.

4.4 The Engineering Design and Description Report (Item 3.3) is required seven months after receipt of order.

DIRECT IMAGE VIEWER TECHNICAL MEETING

AGENDA

Location: STATINTL

Date: 13 July 1964, 10:00 a.m.

1. INTRODUCTORY REMARKS STATINTL

2. REVIEW OF PROJECT SPECIFICATIONS....

3. REVIEW OF PROJECT SCHEDULE STATINTL

4. FINALIZATION OF TECHNICAL DESIGN
PARAMETERS

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5. GENERAL DISCUSSION open

6. SUMMARY OF MEETING STATINTL

Portion of these minutes reflect agreement

between msi, customer & [redacted]

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PROJECT MEETING HELD AT [redacted]

Date: 13 July 1964

1.0 PERSONS PRESENT

Customer

STATINTL [redacted]

STATINTL [redacted]

, Director, Contract and Optics Research and Development

Staff Member, Contract and Optics Research and Development

STATINTL [redacted]

Research Director

STATINTL [redacted]

resident

, Vice President

Project Engineer

2.0 The agenda was presented and copies of schedule and project specifications distributed to attendees (copies of which are attached).

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3.0 [redacted] made introductory remarks describing and reviewing the history of the project.

4.0 Major C. presented a short discussion from the customer's vantage point.

5.0 A review of the project specifications was held. The list below summarizes the discussion.

5.1 Film Size. The discussion was concluded with the agreement to use a 4 x 5 inch chip and sections of 70mm film about 100mm long.

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will furnish with a drawing and/or a sample of the 4 x 5 chip.

5.2 The exit pupil size was discussed with consideration given to the use of two smaller exit pupils with their centers at approximately normal eye spacing. It was concluded that the viewer design does not preclude the action at a later date, if required. Therefore, the large single exit pupil would be continued at this time.

5.3 The objective lense resolution was discussed and the specification changed from 200 l/mm AWAR to 200 l/mm on axis.

5.4 The viewer light source, light level requirement, and band width of illumination generated an active discussion.

Some of the points discussed are listed below:

5.4.1 Broad and narrow band sources were discussed.

5.4.2 It was felt that light intensity would be a problem.

5.4.3 A central band of 508.6nm was selected for use in the viewer.

5.4.4 A decision was made to use a broad band source (Xenon Arc lamp) and filter to the desired wavelength.

5.4.5 Square wave type filters would be used to filter the source. 3%, 5%, and 10% were discussed as useful band passes.

5.4.6 Since the intensity of the lamp cannot be varied it was

decided that a mechanism would be used to vary the illumination falling on the film. A neutral density wedge would be translated through the light path to lower the intensity as required.

5.4.7 Work of others in the light source field was discussed.

Examples:

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[] ASD; active in light source development.
[] also mentioned work done by []

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[] will furnish [] with a copy of the study performed by [] on light sources and condenser systems.

5.6 The film temperature was discussed with emphasis placed on blowing air over the film gate. It was felt that with the intense light source a film temperature of no more than 95° would be difficult. This would be helped by having the emulsion of the film exposed to the air by the use of a vacuum back. A density level of 0.8 was called out for testing and measuring the temperature.

5.7 Two pieces of auxiliary equipment that were planned for the viewer were eliminated. The light source power supply would be placed outside of the viewer and vacuum will be furnished and therefore the pump is not required.

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5.8 The mechanical configuration presented was designed to set on a 30 inch table (standard height) and place the optical path at the average height for comfortable viewing with the operator's head slightly tilted forward. [] preferred a horizontal viewer without any height consideration of optics above the mounting surface. He said adjustable mounting tables were available.

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Also, various methods of laying out the two magnifications were discussed. The approach of interest to [] was to eliminate the mirrors and folds in the optical path if possible.

- 6.0 The next area of discussion was the total project schedule. A small PERT chart was provided which listed individual company schedules and the dependence of the companies on one another and of the schedule on the grating fabrication by [] STATINTL

It was noted that the first 2 x 2 grating would be fabricated and ready for testing, if it is close enough to the specifications to warrant testing, before the viewer optics are completed.

STATINTL A discussion then ensued on the advisability of a simulated optical system to test the grating. This would be given consideration by [] and the appropriate plane made.

STATINTL [] said that due to field lens glass delivery, the optical system schedule could not be altered.

- 7.0 Change in number of diffraction orders required. During the discussion concerning the technical design parameters of STATINTL [] the exit pupil size was reviewed. It became apparent that an oversight had been made up to this time. The spatial exit pupil had been looked upon as 0.4 inches in size. Therefore, nine 0.4 inch exit pupils would give a 3.6" total exit pupil. The 0.4 exit pupil is created by 1.0 inch pupil in the objective reduced 2.5X by the optics. But the 1.0 inch pupil is a circle diameter and when converted to a square becomes the diagonal making a 0.707 in side square. When the 2.5 reduction is applied to this, 0.28 x 0.28 square results.

Then, to retain the 3.5 inch or greater exit pupil 13 orders of diffraction are required. (Six instead of four on a side.) This adds to the grating problem and reduced the overall illumination per order.

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[] has accepted the change from 9 to 13 orders.

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The [] scope of work has to be modified to reflect a total number of orders (diffraction) of thirteen (six on a side). After the second trial of [] Phase II, a meeting will be held to review the progress of the grating effort to determine [] ability to fabricate a grating of 13 orders. If it appears that it is impossible to achieve a 13 order grating, then consideration will be given to splitting the exit pupils into two parts and insert a mirror in the optical path and reduce the grating order requirement to seven (7) orders. This is all predicated on selecting an objective lens that will provide a 1 inch diagonal or greater. Exit pupil (individual) size will be 0.28 inch on a side.

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8.0 Discussion on [] in regard to diffraction grating fabrication. [] reviewed the methods of approach and the most promising method at this time.

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The parameters were settled which affect the efforts of [] Four of these items were:

1. Gratings are to be placed between the two halves of the field lens.
2. Wavelength 5086A
3. Angular deviation to provide 13 exit pupils 0.28 inches apart at a 20 inch distance from the rear nodal point of the field lens.

9.0 Diffraction Grating Substitute - Jarvis mentioned that his

organization (Dick S.) is working on a promising Ronchi Ruling technique (that would be used to create phase gratings) that may be used as a substitute for the diffraction grating.

10.0 Other General Comments

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STATINTL 10.1 [] asked [] to keep his organization informed of any problems and project progress to insure that communications do not fall down.

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10.2 The next meeting will be held at [] during the month of September.

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10.3 The meeting adjourned with [] ready to start their respective study and design phases. [] will wait on starting the mechanical design until the optical design is completed sufficiently to determine the layout and mounting of parts.

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11.0 Required Actions

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11.1 The customer will furnish [] with a drawing and/or a sample of a standard format 4 inch x 5 inch film chip.

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11.2 The customer will furnish [] with two copies of a [] performed study in light sources and condenser systems. One (1) copy will be supplied to []

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STATINTL 11.3 [] will prepare recommendations relative to the use of a simulated optical train for testing the first 2 x 2 inch trial grating upon its completion, rather than await completion of the direct image viewer optical system.

11.4 [] Statement of Work will be appropriately
STATINTL modifeid to increase the number of diffraction orders required
from nine (9) to thirteen (13), and to include as part of
their Phase I effort recommendations relative to the use
of split exit pupils. [] representative
STATINTL [] agreed to the changes as non-cost bearing
changes.

11.5 [] will evaluate the technical feasibility and any attendant
STATINTL changes in project cost and submit recommendations to the
customer, i.e., the use of an in-line optical train to
accomplish the required dual magnifications versus the folded
optical approach previously recommended and incorporated in
project costs.